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H04Q 7/32

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H4L LESF

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EP 0820178 A2 EP 0665655 A2 EP 0639020 A1
WO 00/64093 A1

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INT CL^7 **H04M 1/725 , H04Q 7/32**
ONLINE: WPI, EDOC, JAPIO

(54) Abstract Title
Wireless RF peripheral interface for a cellular communication device

(57) A wireless radio frequency peripheral interface (18) for a cellular communication device (10) having a primary antenna (14), a cellular radio transceiver coupled to the primary antenna (14), and a user interface including a display and a keypad integrated in a housing (16), includes an embedded AM band radio antenna (20), an application interface circuit (26) coupled to the AM band antenna (20), a memory (30), and a processor (28) coupled to the memory (30) and the application interface circuit (26). The processor (28) is adapted to execute a program stored in the memory (30) to control the application interface (26) to process data signals that are conveyed through the AM band antenna (20) to communicate with a peripheral device (42) that is proximate to the communication device (10). Applications to "smart card" access and financial transactions, and to tagging (RFID) are disclosed.

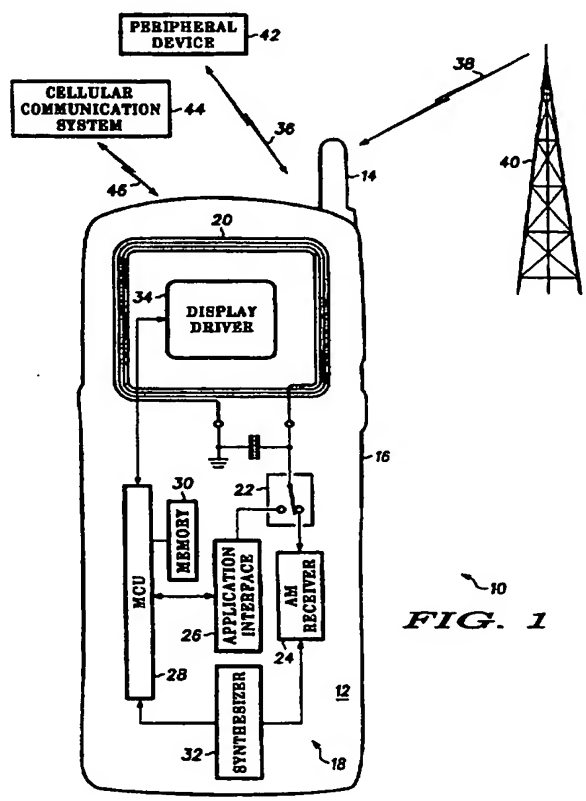


FIG. 1

GB 2 358 991 A

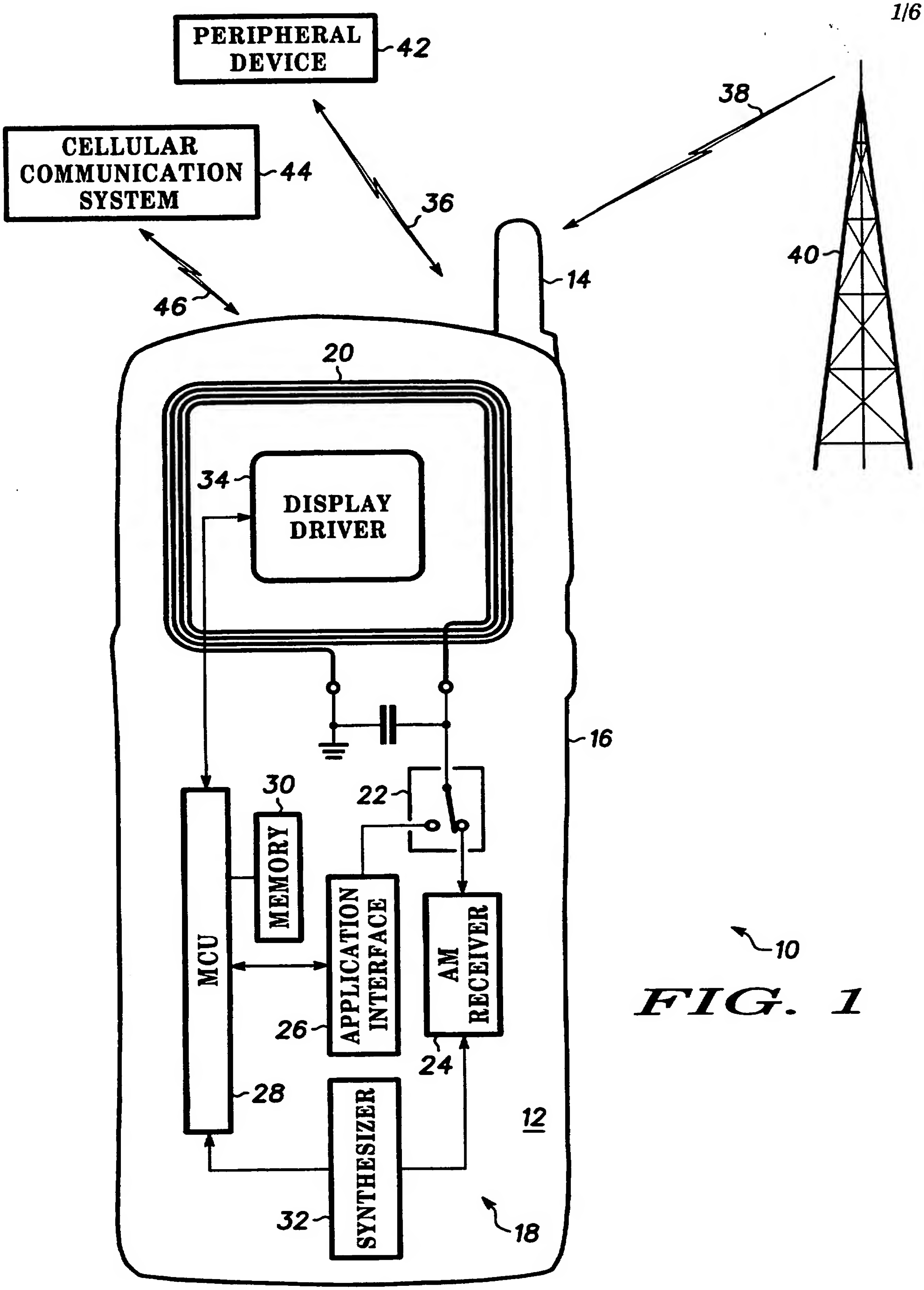

PERIPHERAL DEVICE
42
CELLULAR COMMUNICATION SYSTEM
44
38
36
46
14
40
20
34
DISPLAY DRIVER
16
30
22
MEMORY
MCU
APPLICATION INTERFACE
AM RECEIVER
26
24
28
12
SYNTHESIZER
32
18
10

FIG. 1

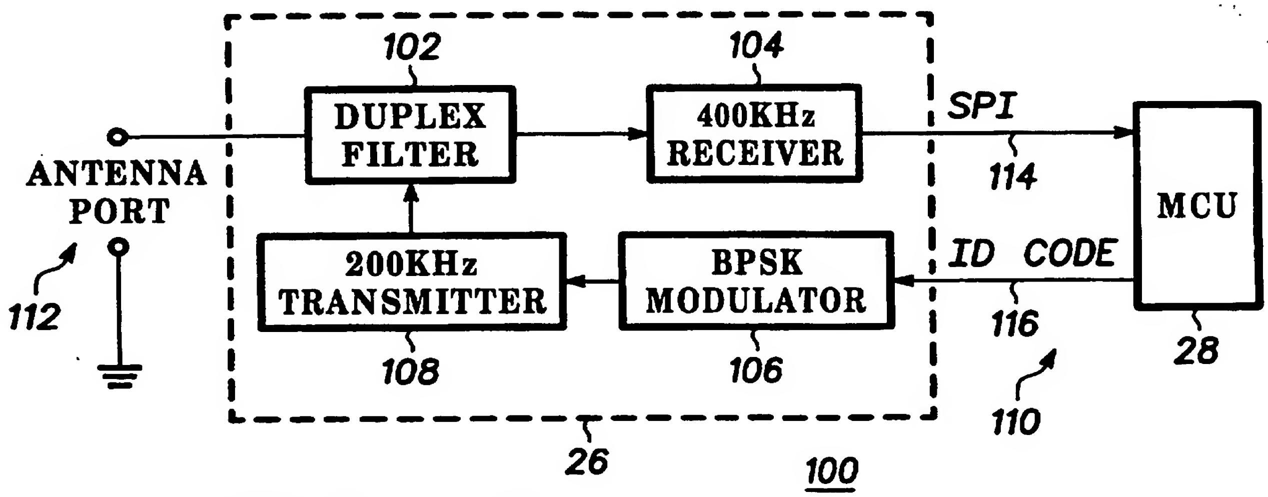


FIG. 2

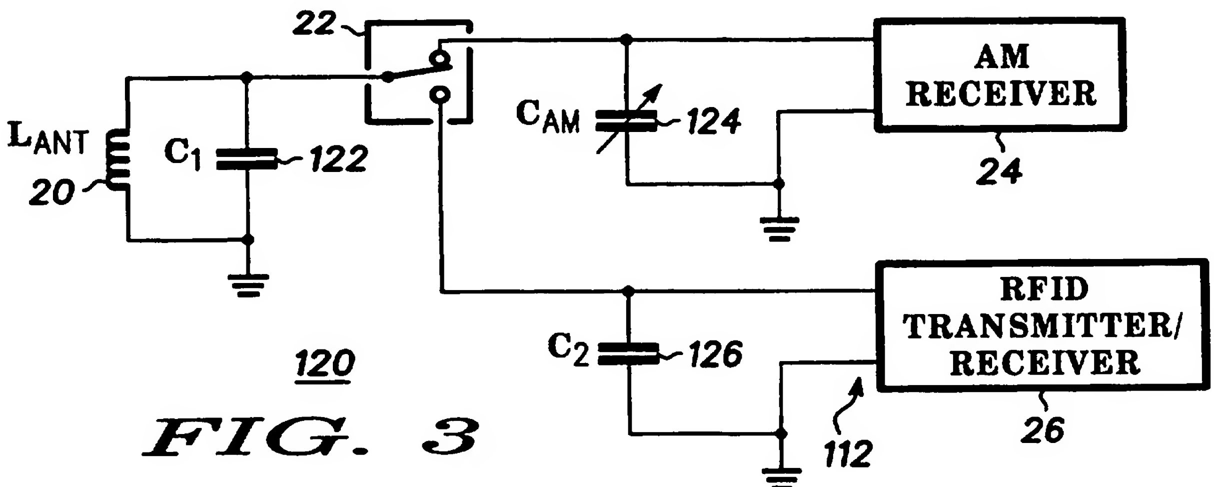


FIG. 3

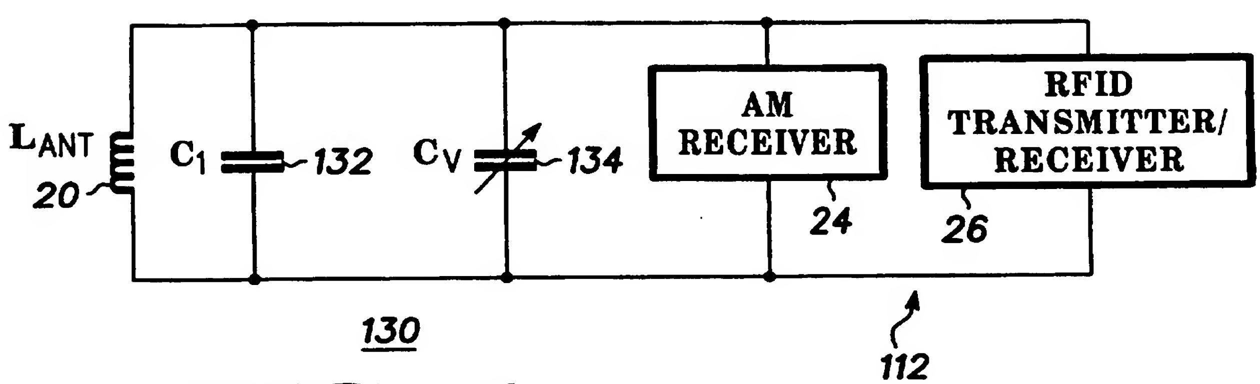


FIG. 4

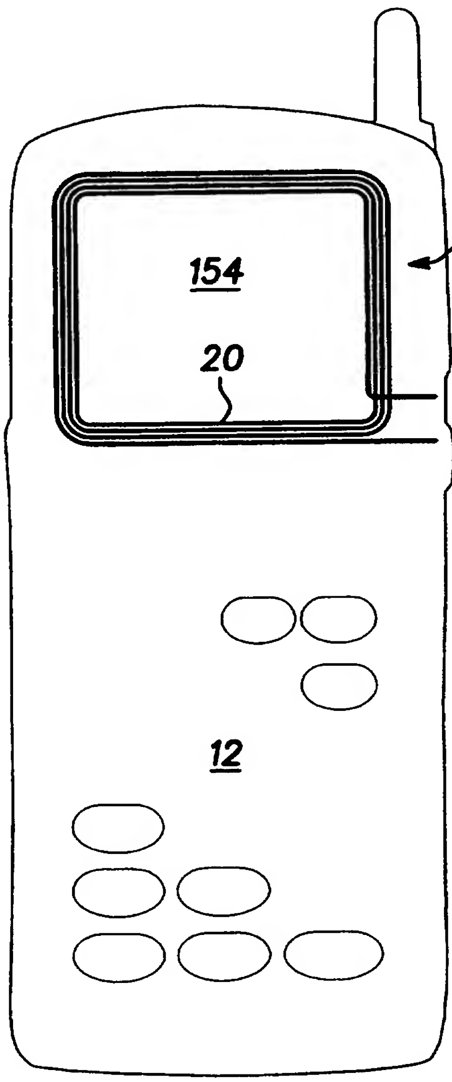


FIG. 5

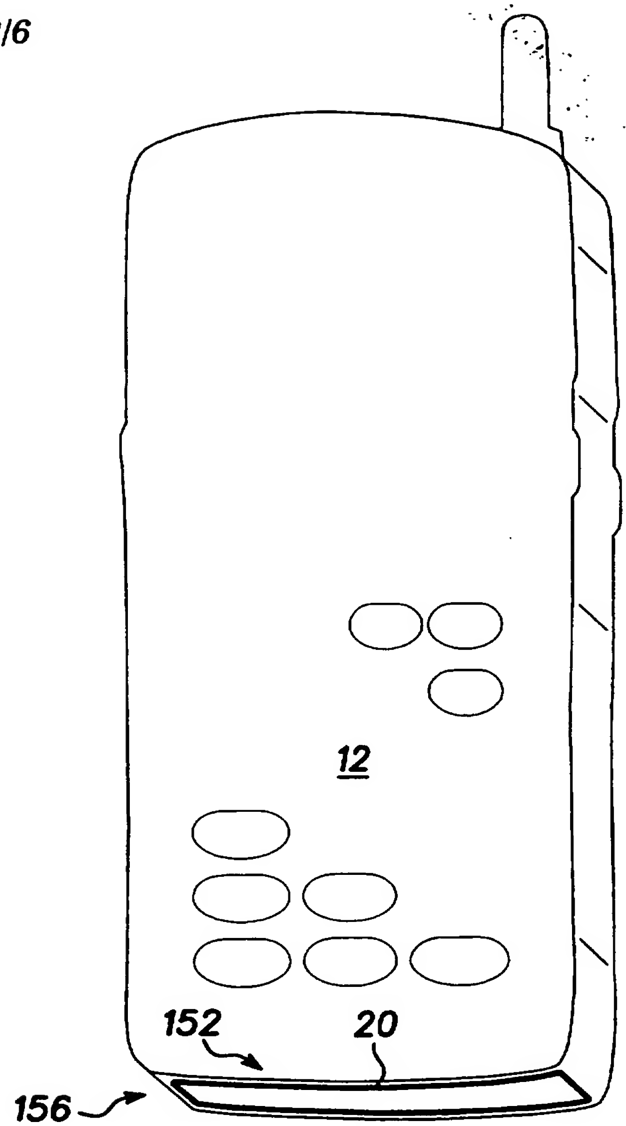


FIG. 6

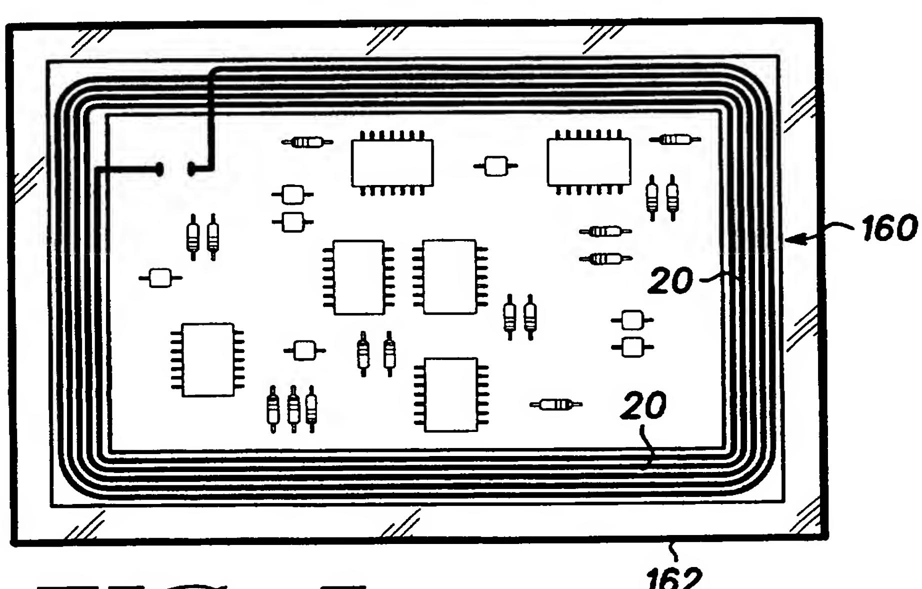


FIG. 7

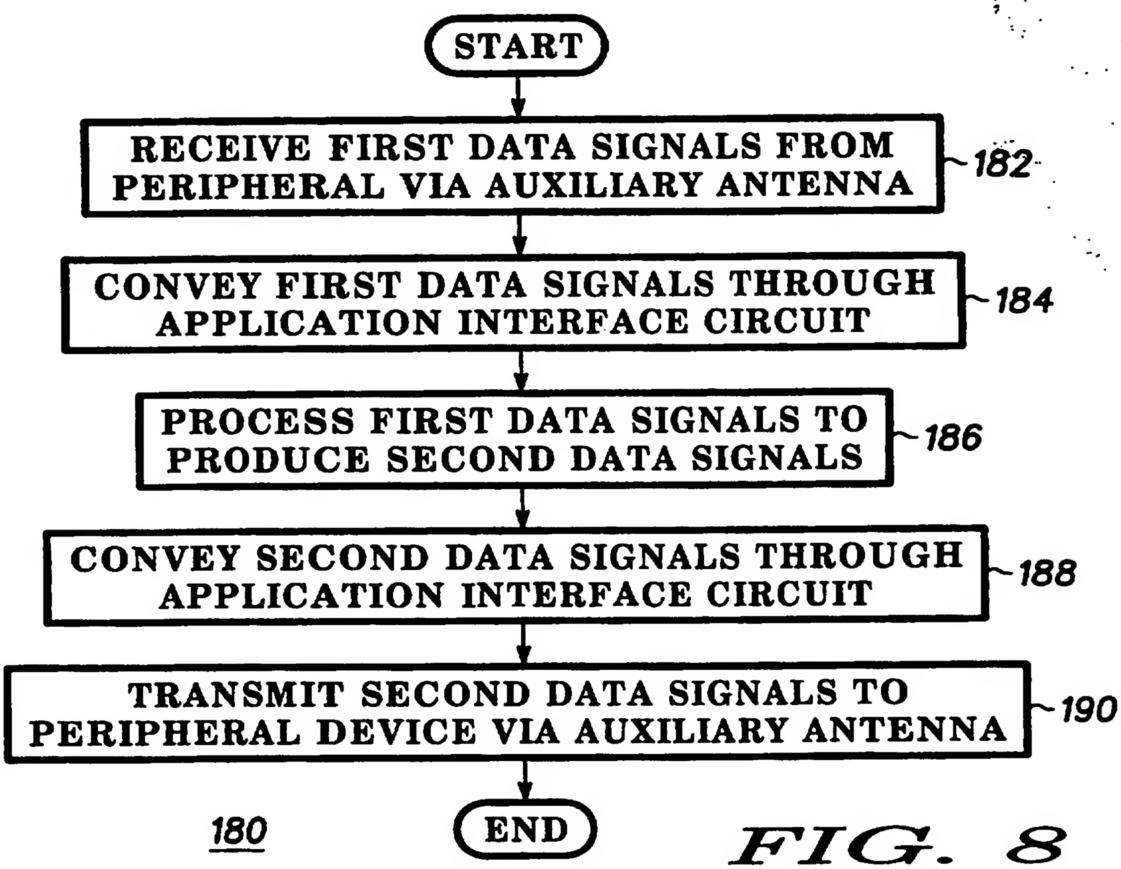

START
RECEIVE FIRST DATA SIGNALS FROM PERIPHERAL VIA AUXILIARY ANTENNA
182
CONVEY FIRST DATA SIGNALS THROUGH APPLICATION INTERFACE CIRCUIT
184
PROCESS FIRST DATA SIGNALS TO PRODUCE SECOND DATA SIGNALS
186
CONVEY SECOND DATA SIGNALS THROUGH APPLICATION INTERFACE CIRCUIT
188
TRANSMIT SECOND DATA SIGNALS TO PERIPHERAL DEVICE VIA AUXILIARY ANTENNA
190
180
END

FIG. 8

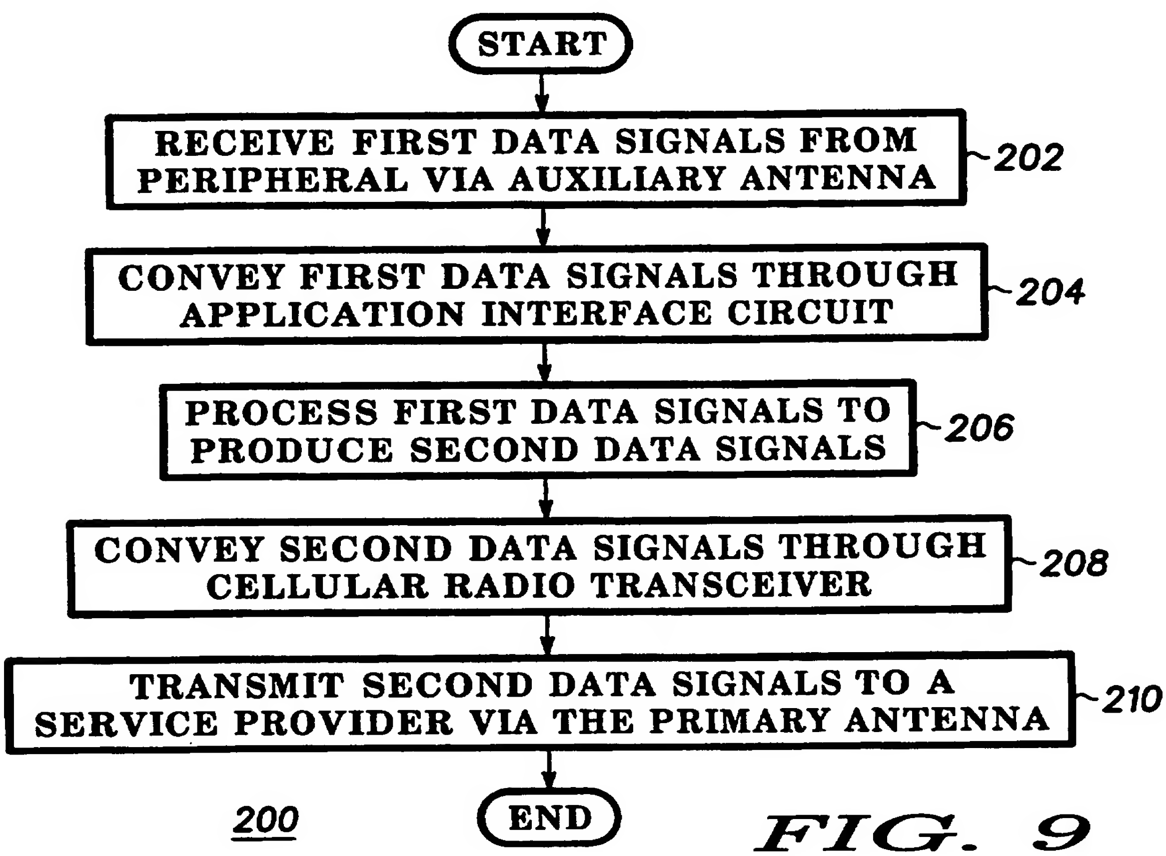
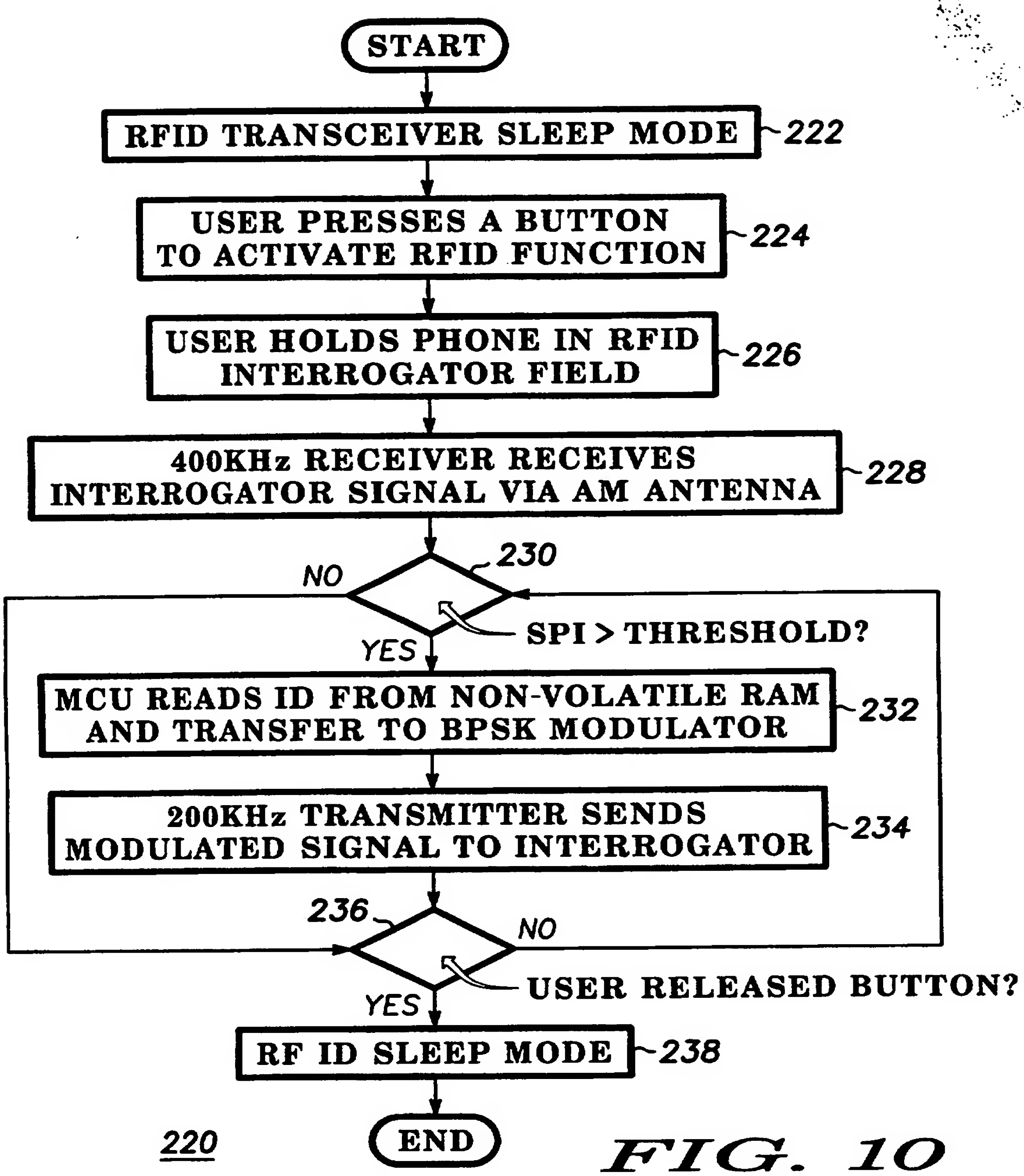

START
RECEIVE FIRST DATA SIGNALS FROM PERIPHERAL VIA AUXILIARY ANTENNA
202
CONVEY FIRST DATA SIGNALS THROUGH APPLICATION INTERFACE CIRCUIT
204
PROCESS FIRST DATA SIGNALS TO PRODUCE SECOND DATA SIGNALS
206
CONVEY SECOND DATA SIGNALS THROUGH CELLULAR RADIO TRANSCEIVER
208
TRANSMIT SECOND DATA SIGNALS TO A SERVICE PROVIDER VIA THE PRIMARY ANTENNA
210
200
END

FIG. 9



START
RFID TRANSCEIVER SLEEP MODE
222
USER PRESSES A BUTTON TO ACTIVATE RFID FUNCTION
224
USER HOLDS PHONE IN RFID INTERROGATOR FIELD
226
400KHz RECEIVER RECEIVES INTERROGATOR SIGNAL VIA AM ANTENNA
228
230
NO
SPI > THRESHOLD?
YES
MCU READS ID FROM NON-VOLATILE RAM AND TRANSFER TO BPSK MODULATOR
232
200KHz TRANSMITTER SENDS MODULATED SIGNAL TO INTERROGATOR
234
236
NO
USER RELEASED BUTTON?
YES
RF ID SLEEP MODE
238
END
220

FIG. 10

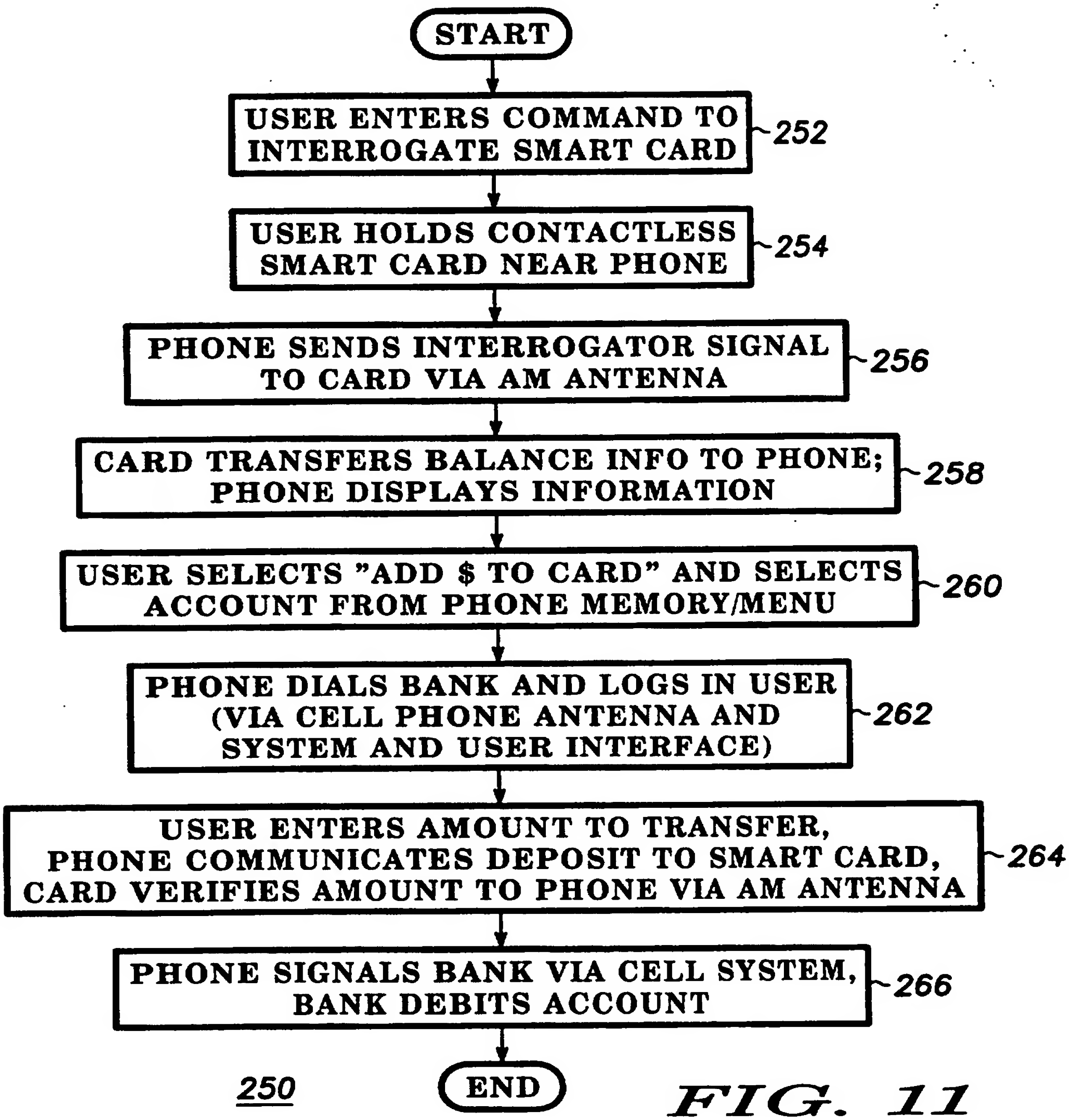

START
USER ENTERS COMMAND TO INTERROGATE SMART CARD
252
USER HOLDS CONTACTLESS SMART CARD NEAR PHONE
254
PHONE SENDS INTERROGATOR SIGNAL TO CARD VIA AM ANTENNA
256
CARD TRANSFERS BALANCE INFO TO PHONE; PHONE DISPLAYS INFORMATION
258
USER SELECTS "ADD $ TO CARD" AND SELECTS ACCOUNT FROM PHONE MEMORY/MENU
260
PHONE DIALS BANK AND LOGS IN USER (VIA CELL PHONE ANTENNA AND SYSTEM AND USER INTERFACE)
262
USER ENTERS AMOUNT TO TRANSFER, PHONE COMMUNICATES DEPOSIT TO SMART CARD, CARD VERIFIES AMOUNT TO PHONE VIA AM ANTENNA
264
PHONE SIGNALS BANK VIA CELL SYSTEM, BANK DEBITS ACCOUNT
266
250
END

FIG. 11

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WIRELESS RADIO FREQUENCY PERIPHERAL INTERFACE FOR A CELLULAR COMMUNICATION DEVICE

FIELD OF THE INVENTION

The present invention relates generally to wireless communication systems. More particularly, the invention relates to a wireless radio frequency peripheral interface for a cellular communication device.

BACKGROUND OF THE INVENTION

Recent trends in consumer electronics have shown an increasing demand for multi-functional portable devices that allow a user to carry a single device that facilitates and/or performs a number of tasks associated with the user's daily activities. For example, palm-top computers have become popular because they allow mobile users to access the Internet, collect and send electronic mail, carry out electronic financial transactions, update and maintain personal planners/schedules, maintain and access lists of personal contacts, keep an electronic notebook, etc. While such mobile multi-functional devices have become commonplace, particularly among business travelers, they are not easily adapted for mobile voice communication applications because they do not meet the form factor and interface requirements for a hand-held cellular phone.

As a result, many business people routinely carry a cellular phone to satisfy their needs for mobile voice communications and a separate device such as a palm- top computer to carry out a variety of daily tasks. Because a large number of people consider a personal cellular phone to be a necessity, many manufacturers have recognized that integrating additional functionality into cellular telephone products provides a way to differentiate their cellular telephone products while providing a higher value for customers. For example, some manufacturers have introduced cellular phones that include computer games, radio broadcast receivers, and global positioning system receivers.

Advances in compact and inexpensive electronic devices have resulted in the proliferation of a wide variety of systems that use radio frequency identification (RFID) cards and "Smart Cards." These systems are typically based on the conveyance of information, via data signals modulated on an amplitude modulation (AM) band carrier signal, between a card or "tag" and a proximate peripheral device. For example, a typical RFID tag system, such as are commercially available from Motorola Indala Corporation, San Jose, California, uses a peripheral device to transmit a 400 kilohertz (kHz) interrogation signal to proximately located security access cards. In response, the security access cards provide identification information to the peripheral device using signals modulated on a 200 kHz carrier. Also, for example, smart card transactions, such as adding a money balance to an existing card, and financial transactions such as bank deposits, balance inquiries, etc., generally require the card holder to travel to a particular location (e.g., an automatic teller machine) to carry out the transaction.

Thus, it would be particularly advantageous to provide a cellular communication device that could additionally accomplish communication activities with a variety of peripheral devices apart from the cellular communication system, thereby eliminating the need for users to carry separate access cards and/or the need to travel to special facilities to carry out financial transactions and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating a multi-function cellular device according to a preferred embodiment of the invention.

FIG. 2 is an exemplary block diagram of an application interface circuit of the multi-function cellular device shown in FIG. 1.

FIG. 3 is an exemplary schematic diagram generally illustrating a circuit for interfacing the application interface circuit of FIGS. 1 and 2 to the auxiliary antenna of FIG. 1.

FIG. 4 is an exemplary schematic diagram generally illustrating an alternative circuit for interfacing the application interface circuit of FIGS. 1 and 2 to the auxiliary antenna of FIG. 1.

FIG. 5 illustrates one possible configuration for the auxiliary antenna of FIG. 1.

FIG. 6 illustrates another possible configuration for the auxiliary antenna of FIG. 1.

FIG. 7 illustrates yet another possible configuration for the auxiliary antenna of FIG. 1.

FIG. 8 is a flow diagram generally illustrating a method of interfacing the multi-function cellular device of FIG. 1 to a peripheral device.

FIG. 9 is a flow diagram generally illustrating another method of interfacing the multi-function cellular device of FIG. 1 to a peripheral device.

FIG. 10 is a flow diagram illustrating a method of interfacing the multi-function cellular device of FIG. 1 to a radio frequency identification system.

FIG. 11. is a flow diagram illustrating a method of interfacing the multi-function cellular device of FIG. 1 to a financial transaction system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will have application apart from the preferred embodiments described herein, and the description is provided merely to illustrate and describe the invention and it should in no way be taken as limiting of the invention.

FIG. 1 is a block diagram illustrating a multi-function cellular device 10 according to the invention. By way of example only, the multi-function cellular device 10 is embodied in a cellular phone 12 having a primary antenna 14 coupled to a conventional cellular radio transceiver (not shown). The cellular phone 12, includes conventional cellular phone hardware (also not shown) such as a keypad and a display that are integrated in a compact housing 16, and further includes a wireless radio frequency peripheral interface 18. The wireless radio frequency peripheral interface 18 includes an auxiliary radio antenna 20 coupled to a switch 22, an AM broadcast receiver 24 coupled to the switch 22,

an application interface circuit 26 coupled to the switch 22, a processor 28 coupled to a memory 30, the application interface circuit 26 and the switch 22, a synthesizer 32 coupled to the processor 28 and the AM broadcast receiver 24, and a display driver 34 coupled to the processor 28, the display and the keypad.

Generally, the processor 28 controls the switch 22 to route AM band radio frequency signals 36, 38 received by the auxiliary antenna 20 to either the AM broadcast receiver 24 or the application interface circuit 26. For example, when the processor 28 controls the switch 22 to route the AM band radio frequency signals 38 transmitted from a remote broadcast station 40, the user may be listening to an AM radio program. In contrast, when the processor 28 controls the switch 22 to route the AM band radio frequency signals 36 associated with a peripheral device 42 through the application interface circuit 26, the application interface circuit 26 processes data signals included in the AM band radio frequency signals 36 to communicate with the peripheral device 42. Furthermore, by rapidly cycling the switch 22, a user can enjoy apparently seamless reception of an AM radio program broadcast while data is being conveyed between the cellular phone 12 and the peripheral device 42 via the auxiliary antenna 20.

In addition to providing a way to accomplish wireless data communications with local peripheral devices, the cellular phone 12 of FIG. 1 also provides a way to establish a communication link or bridge between a conventional cellular communication system 44 and the peripheral device 42. Namely, the processor 28 controls the application interface circuit 26 to convey first data signals to/from the peripheral device 42 via the auxiliary antenna 20. The processor 28 further controls the application interface 26 to process the first data signals to generate second data signals that are conveyed via the primary antenna 14 between the cellular phone 12 and the cellular communication system 44 as cellular transmissions 46. In connection with the above-described communication schemes, the user can interact with the keypad and display of the cellular phone 12 to request, provide, and/or monitor information that is conveyed between the cellular phone 12, the peripheral device 42, or the cellular communication system 44.

The wireless radio frequency peripheral interface 18 can be adapted to accomplish a wide variety of communication applications with a wide variety of peripheral devices. In particular, the application interface circuit 26 and the software executed by the processor 28 are specifically configured to route and process the particular data associated with the particular type of peripheral device with which the wireless radio frequency peripheral interface 18 communicates. For instance, the wireless radio frequency peripheral interface 18 can be adapted to accomplish applications such as radio frequency identification (RFID) where, for example, the cellular phone 12 provides keycard access to a secured location, building, room, etc. Alternatively, the interface 18 can be adapted to accomplish remote financial transactions such as a "Smart Card" type transaction where, for example, the cellular phone 12 provides a data link via the cellular communication system 44 between the user's smart card, bank card, cash card, etc. and an associated financial institution or other service provider. Also, alternatively, the interface 18 can be adapted to accomplish any form of short range communication between the cellular phone 12 and, for example, a headset or a speaker phone. Still further, while the invention is described as being embodied within a cellular phone, it could alternatively be embodied in any other cellular device such as, for example, a pager.

FIG. 2 is an exemplary block diagram 100 of the application interface circuit 26 of FIG. 1. By way of example only, the application interface circuit 26 illustrated in FIG. 2 is specifically adapted to allow the cellular phone 12 to interface with a RFID system that uses interrogation signals on a 400 kHz carrier and response signals on a 200 kHz carrier, such as are commercially available from Motorola Indala Corporation, San Jose, California, for example. The application interface 26 includes a duplex filter 102, a 400 kHz receiver 104, a binary phase shift key (BPSK) modulator 106, and a 200 kHz transmitter 108, all coupled together as shown.

The application interface circuit 26 exchanges information/data with the processor 28 via a data port 110 and exchanges information/data with the auxiliary antenna 20 via an antenna port 112. The data port 110 conveys information associated with interrogation signals received by the cellular phone 12 via the auxiliary antenna 20 from the peripheral device 42, which in this case

is an RFID system peripheral. In particular, the 400 kHz receiver 104 generates a signal presence indicator (SPI) 114 that indicates the presence of an interrogation signal from the peripheral 42 and which is coupled through the data port 110 to the processor 28. The data port 110 also conveys information associated with the identification number of the user of the cellular phone 12 from the processor 28 through the application interface circuit 26 to the auxiliary antenna 20 via the antenna port 112. In response to an SPI 114 value that indicates the presence of an interrogation signal, the processor 28 generates an identification code 116, which passes through the data port 110 to the BPSK modulator 106. The BPSK modulator 106 modulates the identification code 116 and the modulated code is coupled through the 200 kHz transmitter 108, the duplex filter 102, the antenna port 112, the switch 22, and the auxiliary antenna 20, to be transmitted to the peripheral device 42.

FIG. 3 is an exemplary schematic diagram generally illustrating a circuit 120 for interfacing the application interface circuit 26 of FIGS. 1 and 2 to the auxiliary antenna 20 of FIG. 1. The auxiliary antenna 20 is represented as an inductance L_{ant} that is paralleled by a first capacitor 122. A variable capacitor 124 parallels the input of the AM broadcast receiver 24, and a second capacitor 126 parallels the antenna port 112 of the application interface circuit 26. The first and second capacitors 122, 126 are selected so that when the switch 22 couples the auxiliary antenna 20 to the application interface circuit 26, the resonant frequency of the combination of the inductance L_{ant} of the auxiliary antenna 20 and the total capacitance of the first and second capacitors 122, 126 is substantially aligned with a carrier frequency of the RFID system (e.g., 400 kHz). When the switch 22 couples the auxiliary antenna 20 to the AM broadcast receiver 24, the variable capacitor 124 can be varied to tune to a particular AM radio program, for example.

FIG. 4 is an exemplary schematic diagram generally illustrating an alternative circuit 130 for interfacing the application interface 26 of FIGS. 1 and 2 to the auxiliary antenna 20 of FIG. 1. A third capacitor 132 is paralleled with a second variable capacitor 134, and the value of the second variable capacitor 134 is varied so that the total capacitance of the third capacitor 132 plus the adjusted value of the second variable capacitor 134 in combination with the

inductance L_{ant} of the auxiliary antenna 20 provides a resonant frequency that is substantially aligned with the carrier frequency of the application interface circuit 26 or, alternatively, with the carrier frequency of a desired AM radio program to be received by the broadcast AM receiver 24. Thus, the circuit of FIG. 4 eliminates the need for a switch to alternately couple the auxiliary antenna 20 to one of the AM broadcast receiver 24 and the application interface circuit 26.

FIGS. 5 and 6 illustrate first and second possible antenna configurations 150, 152 for the auxiliary antenna 20 shown in FIG. 1. In general, the auxiliary antenna 20 has multiple loops or turns of magnet wire that are integrated with the cellular phone 12. The specifications for the wire, the numbers of turns used, and the geometry of the auxiliary antenna 20 are selected to produce reactances and a Q factor suitable for receiving AM broadcast frequencies. For some applications, such as communication with RFID systems, the auxiliary antenna is adapted to covey signals having frequencies in the range of about 200 kHz to 1600 kHz. In the first and second configurations 150, 152, the auxiliary antenna 20 has approximately fifty turns or loops that are laid out in a planar geometry having a cross sectional area of 2500 square millimeters.

In the first configuration 150, the auxiliary antenna 20 is located adjacent to a display portion 154 of the cellular phone 12 and is preferably embedded or molded into the housing material of the cellular phone 12. In the second configuration 152, the auxiliary antenna 20 is located adjacent to a base portion 156 of the cellular phone 12 and is similarly embedded or molded into the housing material of the cellular phone 12.

FIG. 7 illustrates a third possible configuration 160 for the auxiliary antenna 20 of FIG. 1. In the third configuration 160, the auxiliary antenna 20 is formed with multiple loops of circuit traces on multiple layers of a printed circuit board 162, which are series connected by vias (not shown) spaced on the printed circuit board 162.

While three possible antenna configurations 150, 152, 160 are described above, many locations and/or configurations for the auxiliary antenna 20 are possible without departing from the scope of the invention. For instance, if the cellular phone 12 includes a flip portion, the auxiliary antenna 20 could be located in the flip portion. The precise location of the auxiliary antenna 20 is

preferably selected to minimize interferences between the AM band radio frequency signals 36, 38 associated with the peripheral device 42 and the cellular transmissions 46 associated with the cellular system 44 (FIG. 1).

FIG. 8 is a flow diagram generally illustrating a method 180 of interfacing the multi-function cellular device 10 of FIG. 1 to the peripheral device 42. In step 182 first data signals included in the AM band radio frequency signals 36 are received by the multi-function cellular device 10 from the peripheral device 42 via the auxiliary antenna 20. The first data signals can be digital data and/or analog information associated with the particular communication system or application and peripheral device 42 with which the multi-function cellular device 10 interfaces. In step 184 the first data signals are conveyed through the switch 22 to the application interface circuit 26 and in step 186 the processor 28 executes program steps stored in the memory 30 to process the first data signals 36 to produce second data signals. In step 188 the second data signals are conveyed through the application interface circuit 26 and the switch 22 and in a step 190 the second data signals are transmitted to the peripheral device 42 via the auxiliary antenna 20.

FIG. 9 is a flow diagram generally illustrating another method 200 of interfacing the multi-function cellular device 10 of FIG. 1 to the peripheral device 42. In step 202 first data signals (which are contained in the AM band radio signals 36) are received from the peripheral device 42 via the auxiliary antenna 20. The first data signals can be digital data and/or analog information associated with the particular communication system or application and peripheral device 42 with which the multi-function cellular device 10 interfaces. In step 204 the first data signals are conveyed through the switch 22 to the application interface circuit 26 and in step 206 the processor 28 executes program steps stored in the memory 30 to process the first data signals to produce second data signals. In step 208 the second data signals are conveyed through the cellular radio transceiver and are transmitted to a service provider via the primary antenna 14. The service provider, which could be a bank, a security system provider, etc., is in communication with the cellular communication system 44.

FIG. 10 is a flow diagram illustrating a method 220 of interfacing the multi-function cellular device 10 of FIG. 1 with the peripheral device 42 of an RFID system (FIG. 1). In step 222, the application interface circuit 26 (i.e., RFID transceiver) is initially in a sleep mode to conserve power. In step 224 the user presses a button on the cellular phone 12 to activate (i.e., wake) the application interface circuit 26 to communicate with the peripheral device 42. In step 226 the user brings the cellular phone 12 in proximity to the peripheral device 42 so that it is within the interrogator field of the peripheral device 42 and in step 228 the auxiliary antenna 20 receives first data signals, which are modulated on a 400 kHz carrier, in the application interface circuit 26. In step 228 the 400 kHz receiver 104 generates the SPI 114 and provides the SPI 114 to the processor 28 via the data port 110.

In step 230 the processor 28 compares the SPI 114 to a predetermined threshold to determine if a response should be provided. If the value of the SPI 114 is greater than the predetermined threshold then in step 232 the processor 28 retrieves the identification code 116 from the memory 30 and transfers it to the BPSK modulator 106 via the data port 110. In step 234 the 200 kHz transmitter 108 sends modulated identification information to the antenna port 112 to be conveyed through the switch 22 to the peripheral device 42 via the auxiliary antenna 20. In step 236 the processor 28 determines if the user has released the button. If the user has released the button the processor 28 enters step 238 and puts the application interface 26 into sleep mode, otherwise, the processor 28 returns to step 230. In step 230, if the SPI 114 is less than or equal to the predetermined threshold, the processor enters step 236. Thus, according to the RFID application described in connection with FIG. 10 above, the cellular phone 12 can provide identification codes to an RFID interrogation system, which could be a system that allows/denies access to a structure, such as an office building, a room, a laboratory, etc.

FIG. 11. is a flow diagram illustrating a method 250 of interfacing the multi-function cellular device 10 of FIG. 1 to a financial transaction system. In step 252 the user enters, via the keypad of the cellular phone 12, for example, a command to interrogate a smart card (i.e., the peripheral device 42) and in step 254 the user holds the smart card in proximity to the cellular phone 12. In step

256 the cellular phone 12 sends an interrogator signal via the auxiliary antenna 20 to the smart card, and the smart card responds by transferring balance information to the cellular phone 12. In step 258 the processor 28 can further display the received balance information on the display of the cellular phone 12 via the display driver 34. In step 260 the user indicates via the keypad the amount of money to be added to the smart card and selects the account from which the money is to be withdrawn, and the processor 28 retrieves account information from the memory 30. In step 262 the processor causes the cellular phone 12 to communicate with the user's bank via the cellular radio transceiver and primary antenna 14 and the cellular communication system 44. In step 264 the cellular phone 12 conveys the transferred balance to the smart card via the application interface circuit 26 and the auxiliary antenna 20 and the smart card responds with a verification of the additional balance amount via the auxiliary antenna 20. In step 266 the cellular phone 12 acknowledges to the user's bank that the transfer to the card is complete and the user's bank debits the user's account accordingly.

Many additional changes and modifications could be made to the invention without departing from the fair scope thereof. The scope of some changes is discussed above. The scope of others will become apparent from the appended claims.

CLAIMS

What is claimed is:

1. A wireless radio frequency peripheral interface for a cellular communication device having a primary antenna, a cellular radio transceiver coupled to the primary antenna, and a user interface including a display and a keypad integrated in a housing, the peripheral interface comprising:

an auxiliary radio antenna;

an application interface circuit coupled to the auxiliary antenna;

a memory; and

a processor coupled to the memory and the application interface circuit, wherein the processor is adapted to execute a program stored in the memory to control the application interface to process first data signals that are conveyed through the auxiliary antenna to communicate with a peripheral device that is proximate to the communication device.

2. The communication device of claim 1, wherein the auxiliary antenna is an embedded AM antenna, and further comprising a broadcast AM receiver coupled to the antenna.

3. The communication device of claim 1, wherein the first data signals comprise analog data, and wherein the application interface is adapted to process analog audio information that is conveyed through the auxiliary antenna.

4. The communication device of claim 1, wherein the processor is further adapted to convey second data signals associated with the first data signals through the cellular transceiver and the primary antenna.

5. The communication device of claim 4, wherein the first data signals are conveyed through the cellular radio transceiver and the primary antenna in accordance with an input received from a user via the user interface.

6. The communication device of claim 1, wherein the user interface comprises a switch coupled to one of the application interface and the processor for selecting one of a plurality of operational modes of the application interface.

7. The communication device of claim 1, wherein at least some of the first data signals conveyed through the application interface are associated with at least one of a radio frequency identification system, a financial transaction, a data transfer.

8. The communication device of claim 1, wherein the auxiliary antenna comprises a plurality of conductive loops embedded in at least one of a printed circuit board and the housing.

9. The communication device of claim 1, wherein the cellular communication device is at least one of a cellular telephone and a pager.

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Application No: GB 0022552.4
Claims searched: all

Examiner: Nigel Hall
Date of search: 29 May 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H4L (LESF, LEP, LEUX)

Int Cl (Ed.7): H04M 1/725; H04Q7/32

Other: Online: WPI, EDOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0820178 A2	(MOTOROLA) See whole document	1 at least
A,E	WO 00/64093 A1	(YOON)	
A	EP 0665655 A2	(HEWLETT-PACKARD)	
A	EP 0639020 A1	(FRANCE TELECOM)	

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.